Ectoparasite communities of *Rattus norvegicus* (Rodentia: Muridae) in the surrounding areas of Erhai Lake in Yunnan, China

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Abstract: *Rattus norvegicus* may be as the reservoir host of plague in some domestic plague foci of Yunnan province, and some of its ectoparasite species may be the potential vectors of human diseases. To understand the ectoparasite communities in a population of *R. norvegicus* in the surrounding areas of Erhai Lake and the potential medical and veterinary importance of these ectoparasites are described. Ectoparasite communities of 431 rats *of R. norvegicus* were studied by using Mann-Whitney *U*-tests and Spearman correlation analysis, which were sampled in the surrounding areas of Erhai Lake (a famous fresh water lake in Southwestern China) in Yunnan in 2003 to 2004. The constituent ratio (*C*), prevalence (*P*) and average ectoparasite abundance (*A*) were used to test prevalence and density of ectoparasites. The surveyed areas were located in the wild rodent-type plague focus, one of the 11 known plague foci in China and also an important focus of both scrub typhus and epidemic hemorrhagic fever (EHF). The results indicated that a high proportion (71%, 307 individuals) of the sampled 431 rats was found to be infested with ectoparasites. A total of 47 ectoparasite species, including 23 species of chigger mites, 16 species of mesostigmatid (gamasid) mites, 6 species of fleas and 2 species of sucking lice were collected from *R. norvegicus*. Within this ectoparasite complex, 16 species had previously been reported to be vectors of human disease agents. The results suggest that there is very high species diversity of ectoparasites of *R. norvegicus*.

Key words: *Rattus norvegicus*; ectoparasite; community composition; Erhai Lake; China

1 INTRODUCTION

Rattus norvegicus (Berkenhout, 1769) is a cosmopolitan species in the world and a common species of rodents in some places of Yunnan province, China. It is also an important pest for agriculture, tourism and medicine. Ectoparasites of *R. norvegicus* usually cover a few groups of arthropods, including ticks, trombiculid mites (chiggers), gamasid mites, fleas and sucking lice. Fleas are the vectors of plague and endemic typhus. Human louse, *Pediculus humanus*, has long been proved to be the transmission vector of epidemic typhus, epidemic relapsing fever and trench fever, *etc*. Gamasid mites have been suspected to be the potential vectors or reservoir hosts of some zoonoses. Trombiculid mites (chiggers) can transmit scrub typhus. Ticks are the main vector of forest encephalitis. Understanding the richness of ectoparasite species provides valuable insights into their ecological roles in the regulation of their host populations and communities (Stanko *et al*., 2002; Krasnov *et al*., 2004). Since some species of ectoparasites may be the vectors of disease agents, small mammals such as *R. norvegicus* with higher parasite loads and species richness may harbor more such vectors.

2 MATERIALS AND METHODS

2.1 Field investigation

A field investigation was carried out in the surrounding areas of Erhai Lake in Dali, Yunnan from 2003 to 2004. The rat host, *R. norvegicus* was sampled from three differently oriented areas which stand alongside three cordilleras surrounding the Erhai Lake (a famous fresh water lake in Southwestern China), namely Eastern Wuliang Mountain, Southern Ailao Mountain and Western Cangshan Mountain. The

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three confined oriented areas form three different landscapes within the same zone for the inartificial barrier's isolation of Erhai Lake.

The survey was made in 4 kinds of habitats (indoor habitat, cultivated field, shrub area and forest) in each oriented area surrounding Erhai Lake (99°58′ – 100°27′E, 25°25′ – 25°58′N). At 1 950 – 2 050 m above sea level, the average annual temperature was 15.1℃ and the average precipitation was 110 cm.

2.2 Sampling protocol and specimen identification

The rats (*R. norvegicus*) were randomly captured with cage-traps (10 cm × 12 cm × 18 cm) baited with apples and oil-fried peanuts. The cage-traps were examined and re-baited each morning. A total of 100 traps were used for each study site. Twenty trap stations were set at 10 m intervals along five trap lines. Trap lines were arranged at 10 m intervals. The traps were checked for three consecutive days, and then moved to another place in the same site until the end of observations. A total of 1 500 traps were checked in every site. Trapped mice were put into white cloth bags in the field and brought to the laboratory for identification according to their body shape, size and color, and some measurements such as body length, ear length and length of the hind feet. The ectoparasites on the body surface of *R. norvegicus* were all collected with fine forceps and preserved in labeled vials containing 70% ethanol until they were identified. Fleas and sucking lice were dehydrated in 30%, 50%, 70%, 90% and 100% ethanol at first and then made transparent in the mixed solution of pure ethanol and xylene (xylol). After the dehydration and transparent process, specimens were mounted on slides by using abienic balsam separately. Each specimen was finally identified under a microscope. Gamasid mites and chiggers were rinsed with clean water several times to remove the alcohol and the Hoyer's solution was used to mount specimens on glass slides for viewing under a stereomicroscope. Slide-mounted ectoparasites were identified to species under a microscope after the clearing and drying process (Chin and Li, 1991; Guo *et al.*, 2000; Luo *et al.*, 2007; Men *et al.*, 2007).

2.3 Statistical analysis

According to the ectoparasite categories such as fleas, sucking lice, chiggers and gamasid mites, the following formulae were used to calculate the constituent ratio (C), prevalence (P) and average ectoparasite abundance (A) of each category (Men *et al.*, 2007).

$$C = \frac{N_i}{N} \times 100\% \; ; P = \frac{H_i}{H} \times 100\% \; ; A = \frac{N_i}{H} \times 100\%.$$

Where N_i represents the individuals of a certain ectoparasite category i (chiggers, gamasid mites, fleas or sucking lice) and N represents the total individuals of all ectoparasites. H represents the total individuals of rat hosts (*R. norvegicus*) and H_i represents the individual rat hosts parasitized by a certain ectoparasite category i. Non-parametric Mann-Whitney U-tests were used to test differences in the abundance and richness of ectoparasites (total ectoparasites, chiggers, gamasid mites, fleas or sucking lice) between female and male hosts. Spearman correlation analysis was used to analyze the relationship between ectoparasites (total ectoparasites, chiggers, gamasid mites, fleas or sucking lice) and the body parameters of rat hosts.

3 RESULTS

3.1 Collection of hosts and ectoparasites

A total of 431 *R. norvegicus* (210 males and 221 females) were captured. A total of 8 025 individual ectoparasites were collected and 47 species were identified, including 23 species of chiggers, 16 species of gamasid mites, 6 species of fleas and 2 species of sucking lice (Table 1).

A large proportion (71%) of *R. norvegicus* (431 individuals) was infested with ectoparasites and the average ectoparasite abundance reached 18.65 (Table 2). Sucking lice were the most numerous among the four ectoparasite categories, followed by gamasid mites. Both the sucking lice and gamasid mites were far more abundant than chiggers and fleas (Table 2 and 3).

This study revealed that significant differences existed between male and female rats in terms of total ectoparasite abundance and sucking louse abundance. However, no significant differences between male and female hosts were detected in chigger abundance, flea abundance or gamatid mite abundance (Table 4).

Similarly, the species richness of chiggers, fleas or gamasid mites had no significant difference between male and female hosts. However, a significant difference between male and female hosts was detected in total ectoparasite richness and sucking louse richness (Table 5).

3.2 Correlation between ectoparasites and host body parameters

Correlation analysis showed that flea abundance and species richness, together with the total ectoparasite species richness, were positively correlated with the body weight of the rat hosts ($r = 0.172$, $df = 431$, $P = 0.000$ for flea abundance; $r = 0.199$, $df = 431$, $P = 0.000$ for flea richness; $r = 0.107$, $df = 431$, $P = 0.026$ for all ectoparasite richness). No correlations were observed between the host body parameters and the abundance of total ectoparasites, gamasid mites, sucking lice and chiggers. Similarly, no correlations were observed between the host body parameters and richness of gamasid mites, sucking lice and chiggers.

Table 1 Ectoparasite categories collected from *Rattus norvegicus* in the surrounding areas of Erhai Lake in Yunnan, China from 2003 to 2004

Species of ectoparasites	Number of individuals	Species of ectoparasites	Number of individuals
Chigger mites		*Eulaelaps substabularis*	1
Ascoschoengastia indica *	2	*Haemolaelaps casalis* *	1
Ascoschoengastia leechi	1	*Haemogamasus pontiger* *	5
Ascoschoengastia rattinorvegici	127	*Hirstionyssus sunci* *	61
Cheladonta micheneri	1	*Hypoaspis pavlovskii*	4
Gahrliepia madun	3	*Laelaps algericus*	1
Helenicula simena	24	*Laelaps chini*	1
Herpetacarus hastoclavus	7	*Laelaps echidninus* *	380
Leptotrombidium akamushi *	36	*Laelaps guizhouensis*	3
Leptotrombidium bambicola	1	*Laelaps nuttalli*	823
Leptotrombidium bengbuense	48	*Laelaps turkestanicus* *	1
Leptotrombidium insulare *	6	*Laelaps xingyiensis*	4
Leptotrombidium jinmai	3	*Ornithonyssus bacoti* *	1 226
Leptotrombidium kitasatoi	1	*Proctolaelaps pygmaeus*	13
Leptotrombidium rusticum	3	Species undetermined	1
Leptotrombidium scutellare *	5	Fleas	
Leptotrombidium shanghaense	1	*Leptopsylla segnis* *	182
Leptotrombidium shuqui	21	*Macrostylophora euteles*	1
Leptotrombidium sinicum	12	*Monopsyllus anisus* *	35
Leptotrombidium taishanicum	2	*Frontopsylla spadix spadix* *	190
Leptotrombidium yui *	10	*Paradoxopsyllus custodis* *	359
Trombiculindus yunnanus	1	*Xenopsylla cheopis* *	90
Walchia koi	5	Sucking lice	
Species undetermined	25	*Hoplopleura pacifica*	118
Gamasid mites		*Polyplax spinulosa*	4 189
Androlaelaps singularis	6		

*: Indicating this ectoparasite is a vector of human disease.

Table 2 Constituent ratio, prevalence and average abundance of ectoparasites on *Rattus norvegicus* in the surrounding areas of Erhai Lake in Yunnan, China

Ectoparasite category	Number of individuals	Number of species	Constituent ratio (C)	Prevalence (P)	Average abundance (A)
All ectoparasites	8 040	47	100.00	71	18.65
Chiggers	345	23	4.23	7	0.80
Sucking lice	4 307	2	53.57	29	9.99
Gamasid mites	2 531	16	31.48	43	5.87
Fleas	857	6	10.61	33	1.99

4 CONCLUSIONS AND DISCUSSION

In the investigation, chiggers are the ectoparasite taxa with the highest species richness, of which 23 species were found on *R. norvegicus* (Table 1 and 2). Of these chigger species, *Ascoschoengastia rattinorvegici* Wen, *Leptotrombidium bengbuense* Chen and *Leptotrombidium akamushi* Barumpt are the most abundant three chigger mite species, accounting for 36.81%, 13.91% and 10.43% of all chigger mites (Table 3). About 3 000 species of chiggers have been recorded in the world and more than 400 species in China. Of the recorded chigger species in China, 12

Table 3　Dominant species (representing > 10% of its group) in the four categories of ectoparasites on *Rattus norvegicus*

Species of ectoparasites	Number of individuals	Proportion of individuals in a certain category (%)
Chiggers		
Ascoschoengastia rattinorvegici	127	36.81
Leptotrombidium bengbuense	48	13.91
Leptotrombidium akamushi	36	10.43
Mesostigmatid mites		
Ornithonyssus bacoti	1 226	48.44
Laelaps nuttalli	823	32.52
Laelaps echidninus	380	15.01
Fleas		
Paradoxopsyllus custodis	359	41.89
Frontopsylla spadix spadix	190	22.17
Leptopsylla segnis	182	21.24
Xenopsylla cheopis	90	10.51
Sucking lice		
Polyplax spinulosa	4 189	97.26

Table 4　Mann-Whitney *U* test for the abundance of different ectoparasite categories on female and male rat hosts (*Rattus norvegicus*)

Ectoparasite categories	Ectoparasite abundance per host		Mann-Whitney *U* test Significance (2 tailed)
	Female host	Male host	
All ectoparasites	18.49	18.76	0.005
Chigger mites	0.62	0.92	0.390
Sucking lice	11.97	7.91	0.001
Fleas	1.94	2.04	0.278
Gamasid mites	3.96	7.88	0.116

Table 5　Mann-Whitney *U* test for the species richness of ectoparasites on female and male rat hosts (*Rattus norvegicus*)

Ectoparasite categories	Ectoparasite abundance per host		Mann-Whitney *U* test Significance (2 tailed)
	Female host	Male host	
All ectoparasites	1.38	1.72	0.020
Chigger mites	0.11	0.13	0.395
Sucking lice	0.24	0.40	0.001
Fleas	0.43	0.50	0.184
Gamasid mites	0.64	0.69	0.116

species have been proved to be the vectors of scrub typhus in China (Li, 1997; Fang *et al*., 2005). In the investigation, one of the most abundant three chigger mite species, *L. akamushi* fell within the scope of the 12 species. *L. insulare* Wei (6 individuals), *L. scutellare* Nagayo (5 individuals) and *Leptotrombidium yui* (10 individuals) are vectors of scrub typhus in China. Especially, *L. scutellare* is one of the main vectors of chigger mites transmitting *Q. tsutsugamushi* to humans to cause scrub typhus in China (Li, 1997). *L. scutellare* has also recently been shown to be vectors of EHF virus (Wu *et al*., 1996; Li *et al*., 1997; Song, 2000; Men *et al*., 2007). *L. deliense* has long been considered as the main vector of scrub typhus in Yunnan and also the main chigger species on house rats including *R. norvegicus*. Our investigation, however, did not support the former consideration (We did not find *L. deliense*). Instead, *A. rattinorvegici*,

L. bengbuense and *L. akamushi* are the most abundant chigger species on *R. norvegicus*. Our results seem strange, but very interesting, which should be stressed. If *L. deliense* is not the dominant chigger species on house rats such as *R. norvegicus*, *R. flavipectus* and some other house rat species, the former consideration should be revised about the main vector of scrub typhus. We can not explain the interesting results properly at the moment and further researches may need to be done.

Gamasid mites on small mammals constituent a larger group of ectoparasites that are related to many human disease; 16 gamasid mite species were observed on *R. norvegicus* in this study (Table 1), *Ornithonyssus bacoti* Hirst, the most abundant gamasid mite, of which 1 226 individuals were collected in this study, is a potential reservoir of *endemic typhus*, *rickettsia pox* and acariasis, which is caused by the direct parasitism of some gamasid mites within the human body and skin anaphylaxis by the mites' biting (Ader and Wills, 2003; Durden *et al.*, 2004; Fang *et al.*, 2005). *O. bacoti* has been widely researched all over the world, because not only can it cause human dermatitis, rickettsia pox and transmit EHF, but it has also been suspected as a vector of forest encephalitis, endemic typhus, Q fever, tularemia, plague, tick-borne relapsing fever and potential vectors of lymphocytic choriomeningitis and leptospirosis (Deng *et al.*, 1993). *Laelaps echidninus* Berlese, of which 380 individuals were collected in this study, is a potential reservoir of *Yersinia pestis*, *Coxiella burnetii*, *O. tsutsugamushi*, *endemic typhus* and *Leptospira interrogans* (Wang *et al.*, 1996; Fang *et al.*, 2005). It was reported that *L. echidninus* can cause papular urticaria (Zhao, 2002). *Haemolaelaps casalis* (1 individual) could cause human dermatitis, and has been suspected as a transmitting vector or potential vector of some epidemic infectious diseases, such as forest encephalitis, Q fever, North Asian tick-borne typhus (Deng *et al.*, 1993; Fang *et al.*, 2005). Similarly, *Hirstionyssus sunci* Wang (1 individual) and *Haemogamasus pontiger* Berlese (5 individuals) could cause human dermatitis (Deng *et al.*, 1993). *Laelaps turkestanicus* Lange (1 individual) was also reported to be associated with human diseases.

Fleas can cause skin damage and anaphylaxis by biting human and sucking blood, and can also transmit zoonotic pathogens such as those cause endemic typhus and tularaemia. However, they are best known as vectors of plague bacilli. In this investigation, six species of fleas were observed on *R. norvegicus*, five of them had been previously reported to be naturally infected with *Y. pestis* (Table 1). *Paradoxopsyllus custodis* Jordan was the most abundant species of the fleas observed, accounting for 359 individuals or 41.89% of all fleas collected (Table 3), transmitting plague bacilli to humans. *Frontopsylla spadix spadix* Jordan *et* Rothschild (190 individuals collected in this survey) may play an important role in the enzootic maintenance of plague in the sylvatic plague focus, although its vector efficiency and index are about 20% and 17%, respectively, of those of *Neopsylla specialis specialis*, and it is also able to carry *Y. pestis* for much longer periods than *N. specialis specialis* and hence may play an important role in the enzootic maintenance of plague in the plague focus (Wu, 2007). *Leptopsylla segnis* Schonheer (182 individuals collected in this survey) is not believed to be able to transmit plague bacilli because experiments have showed that both its vector efficiency and vector index are zero, although its infection rate was more than 80% (Liang *et al.*, 1994; He *at al.*, 1997). It is well known that *Xenopsylla cheopis* Rothschild (90 individuals collected in this survey) is an important vector of plague bacilli in the world. Experiments have showed that it was also important vector of plague in China (Wu, 2007). *Monopsyllus anisus* Rothschild (35 individuals collected in this survey) may play an important role in the enzootic maintenance of plague in the plague focus.

Sucking lice (4 307 individuals) collected were the most numerous among the four ectoparasite groups in our survey. *Polyplax spinulosa* Burmeister was the most numerous sucking lice, of which 4 189 individuals were collected in this study. *P. spinulosa* was not also reported to be associated with human diseases, and much more researches need to be made.

In terms of the abundance of total ectoparasites and sucking lice, a significant difference was found to exist between male and female rats, but no significant difference in chigger abundance, flea abundance and gamasid abundance by using Mann-Whitney *U*-test. Similarly, the species richness of both total ectoparasites and sucking lice also showed a significant difference between male and female rat hosts, but no significant difference in chigger mite richness, flea richness and gamasid richness. Correlation analysis showed that the flea abundance and species richness of total ectoparasites and fleas were positively correlated with the body weight of the rat host, but no correlations were observed between host body weight and abundance of total ectoparasites, gamasid mites, sucking lice or chigger mites, while no correlations were observed between host body weight and richness of gamasid mites, sucking lice or chigger mites. The above results are interesting phenomena, but it is difficult to explain the detail mechanism of the phenomena. More research work may need to explain why the phenomena happened.

Of the sampled 431 rats (*R. norvegicus*), only one individual was found in forest, 9 in shrub, 13 in cultivated areas and 408 in human dwellings. The results reveal that the major habitat for *R. norvegicus* is human dwellings and nearby cultivated areas, indicating the higher possibility of disease transmission since it is easy for humans to contact the rats and their ectoparasites in human dwellings and nearby cultivated areas.

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References

Adler PH, Wills W, 2003. The history of arthropod-borne human diseases in South Carolina. *American Entomologist*, 49: 216 – 228.

Chin TH, Li KC, 1991. The Anoplura and Siphonaptera of Guizhou. Guizhou Science and Technology Press, Guiyang. 155 – 388. [金大雄，李贵真，1991. 贵州吸虱类蚤类志. 贵阳：贵州科技出版社. 155 – 388]

Deng GF, Wang DQ, Gu YM, 1993. Economic Insect Fauna of China. Fasc. 40. Acari: Dermanyssoidea. Science Press, Beijing. 391 pp. [邓国藩，王敦清，顾以铭，1993. 中国经济昆虫志，第 40 册，蜱螨亚纲，皮刺螨总科. 北京：科学出版社. 391 页]

Durden LA, Polur RN, Nims T, Banks CW, Oliver JH Jr, 2004. Ectoparasites and other epifaunistic arthropods of sympatric cotton mice and golden mice: Comparisons and implications for vector-borne zoonotic diseases. *American Journal of Parasitology*, 90: 1 293 – 1 297.

Fang MY, Lin LH, Liu JW, 2005. Arthropod-borne Infectious Diseases. Military Medical Science Press, Beijing. 471 pp. [方美玉，林立辉，刘建伟，2005. 虫媒传染病. 北京：军事医学科学出版社. 471 页]

Guo XG, Gong ZD, Qian TJ, Feng XG, Duan XD, Li W, Zhang XK, 2000. The comparison between flea communities on ten species of small mammals in the foci of human plague in Yunnan, China. *Entomologia Sinica*, 7(2): 169 – 177.

He JH, Liang Y, Zhang HY, Zhao WH, Wu MS, Hu XL, Yang ZM, 1997. A study on the transmission of plague though seven kinds of fleas in rat type and wild rodent type plague foci in Yunnan. *Chinese Journal of Epidemiology*, 18(4): 236 – 240. [何晋侯，梁云，张洪英，赵文红，吴明寿，胡晓玲，杨智明，1997. 云南省家野两型疫源地七种主要蚤类传播鼠疫的实验研究. 中华流行病学杂志，18(4): 236 – 240]

Krasnov BR, Shenbrot GI, Khokhlova IS, Degen AA, 2004. Flea species richness and parameters of host body, host geography and host 'milieu'. *Journal of Animal Ecology*, 73: 1 121 – 1 128.

Li JC, 1997. Trombiculid Mites of China: Studies on Vector and Pathologen of Tsutsugamushi Disease. Guangdong Science and Technology Press, Guangzhou. 570 pp. [黎家灿，1997. 中国恙螨，恙虫病媒介与病原体研究. 广州：广东科技出版社. 570 页]

Liang Y, He JH, Zhao WH, Wu MS, Hu XL, 1994. A study on biology and vector efficiency in the transmission of plague of *Xenopsylla cheopis* and *Leptopsylla segnis*. *Chinese Journal of Endemiology*, 13(6): 380 – 381. [梁云，何晋侯，张洪英，赵文红，吴明寿，胡晓玲，1994. 印鼠客蚤缓慢细蚤的生物学特性及鼠疫媒介效能. 中国地方病学杂志，13(6): 380 – 381]

Luo LP, Guo XG, Qian TJ, Wu D, Men XY, Dong WG, 2007. Distribution of gamasid mites on small mammals in Yunnan, China. *Insect Science*, 14: 71 – 78.

Men XY, Guo XG, Dong WG, Niu AQ, Qian TJ, Wu D, 2007. Ectoparasites of Chevrier's field mouse, *Apodemus chevrieri*, in a focus of plague in Southwest China. *Medical and Veterinary Entomology*, 10: 1 – 4.

Song G, 2000. Achievements in research of epidemic hemorrhagic fever in China. *Chinese Journal of Epidemiology*, 21(5): 378. [宋干，2000. 新中国流行性出血热防治研究的主要成就. 中华流行病学杂志，21(5): 378]

Stanko M, Miklisová D, de Bellocq JG, Morand, S, 2002. Mammal density and patterns of ectoparasite species richness and abundance. *Oecologica*, 131: 289 – 295.

Wang L, Jin LX, Qi ZZ, 1996. The checklist of arthropods naturally infected with *Y. pestis* in each natural focus of plague in China. Endemic Diseases Bulletin, 11(1): 50 – 53. [王丽，金丽霞，祁芝珍，1996. 中国各鼠疫自然疫源地自然感染鼠疫菌节肢动物名录. 地方病通报，11 (1): 50 – 53]

Wu GH, Zhang Y, Guo HB, Zhao XZ, Zhang BG, Yu MM, Jiang KJ, Zhang JJ, Fan GW, Men RH, Gan YH, Qian JY, 1996. The role of *Leptrombidium scutellare* in the transmission of human diseases. *Chin. J. Prev. Med.*, 30(3): 133 – 135. [吴光华，张云，郭恒彬，赵学忠，张炳根，于明明，姜克俭，张家驹，范根蔚，门儒和，甘粤怀，钱俊英，1996. 小盾纤恙螨在传播人类疾病中的作用. 中华预防医学杂志，30(3): 133 – 135]

Wu HY, 2007. Fauna Sinica, Insecta, Siphonaptera. Science Press, Beijing. 2 174 pp. [吴厚永，2007. 中国动物志，昆虫纲，蚤目. 北京：科学出版社. 2 174 页]

Zhao H, 2002. Two cases of papular urticaria caused by *Laelaps echidninus*. *Journal of Clinical and Experimental Medicine*, 1(4): 255. [赵绘，2002. 毒厉螨致丘疹性荨麻疹 2 例. 临床和实验医学杂志，1(4): 255]

中国云南洱海周边褐家鼠的体表寄生虫群落组成

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摘要： 褐家鼠 *Rattus norvegicus* 可能是云南省部分鼠疫流行区的储存宿主之一，其体表的某些寄生虫种类可能是人类疾病的传播媒介。为了解洱海周边地带褐家鼠的体表寄生虫群落，并对其医学和兽医学的重要性进行描述。用 U 检验和相关分析的统计方法对 2003 – 2004 年采自云南洱海（中国滇西北著名的淡水湖泊）周边地区的 431 头褐家鼠的体表寄生虫群落进行了研究。用构成比（C），侵染率（P）和平均丰富度（A）反映体表寄生虫的流行和密度状况。调查点位于我国 11 大鼠疫自然疫源地之一，此地也是我国恙虫病和流行性出血热的流行地区。结果表明：431 头褐家鼠中 307 头寄生有体表寄生虫，侵染率为 71%。采集到的体表寄生虫有 47 种，包括 23 种恙螨、16 种革螨、6 种蚤和 2 种吸虱，其中 16 种以前已经被证明是人类疾病的媒介。结果提示褐家鼠的体表寄生虫物种多样性高。

关键词： 褐家鼠；体表寄生虫；群落组成；洱海；中国

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